(12) UK Patent Application (19) GB (11) 2 260 937 (13) A

(43) Date of A publication 05.05.1993

(21) Application No 9123178.7

(22) Date of filing 01.11.1991

(51) INT CL[5]
B32B 31/28, G02C 7/02

(52) UK CL (Edition L)
B5N N195 N196 N207 N21Y N211 N223 N3128 N46X N494 N500 N57Y N735 N757 N758 N771 G2J JS6DX U1S S1676 S1916

(56) Documents cited
None

(58) Field of search
UK CL (Edition K) B5N, G2J JS6DX
INT CL[5] B29D, B32B, C03B, G02C
Online databases: WPI, CLAIMS

(71) Applicant
Pilkington Visioncare Inc

(Incorporated in the USA - Delaware)

Suite 200, 2420 Sand Hill Road, Menlo Park, California 94025, United States of America

(72) Inventor
Rock Weir

(74) Agent and/or Address for Service
Michael John Lee
Pilkington Plc, Group Patents Department, Pilkington Technology Centre, Hall Lane, Lathom, Ormskirk, Lancashire, L40 5UF, United Kingdom

(54) **Manufacturing laminated lenses**

(57) Laminated ophthalmic lenses are manufactured by laminating two lens wafers (12, 13) together with an adhesive (14) cured by exposure to a uv light source which also emits thermal radiation. The thermal radiation is prevented from reaching the wafers during bonding by a filter mechanism. By filtering out the thermal radiation, the number of finished laminated lenses which are rejected due to distortion induced power errors is reduced.

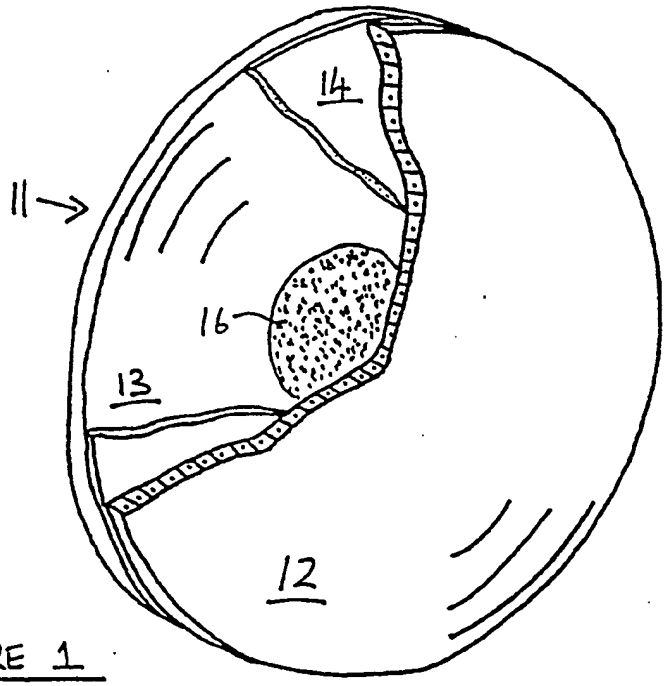

FIGURE 1

GB 2 260 937 A

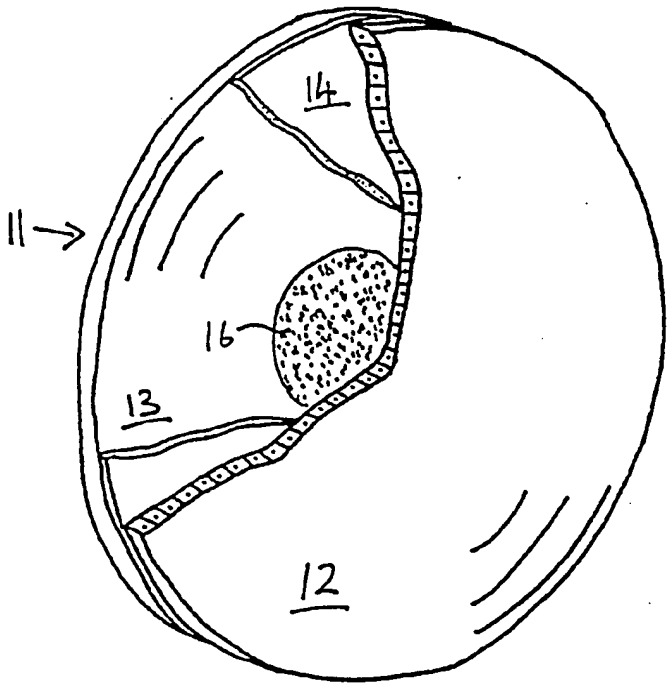

FIGURE 1

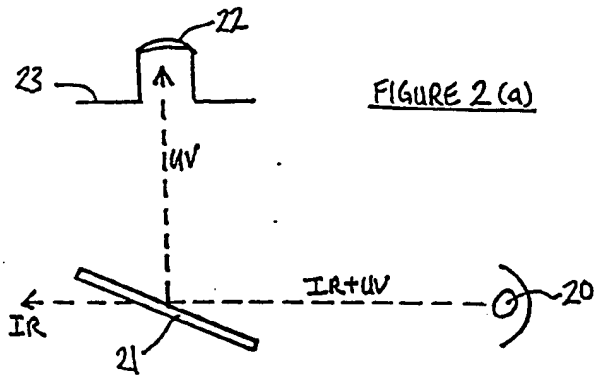

FIGURE 2 (a)

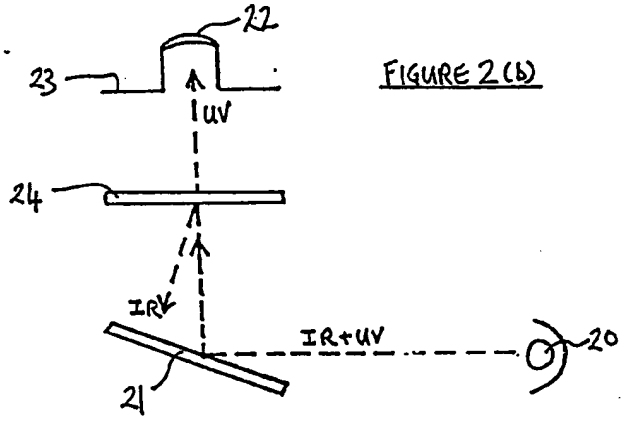

FIGURE 2 (b)

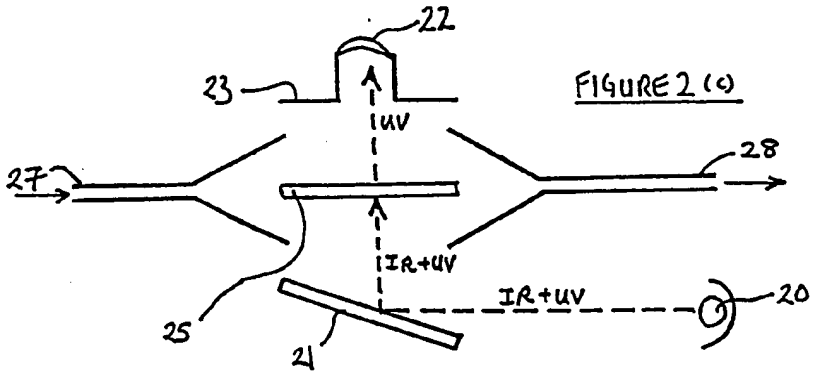

FIGURE 2 (c)

2263737

IMPROVEMENTS IN OR RELATING TO LAMINATED LENSES AND THEIR METHOD OF MANUFACTURE

This invention relates to ophthalmic lenses and their manner of manufacture. More particularly it relates to laminated ophthalmic lenses and their manner of manufacture.

Lenses are made to meet the needs of a particular person by combining in the one lens a specific combination of optical parameters that meet that need. It is not practical to carry a stock of lenses which will include every possible combination that may be needed, consequently most eyeglass lenses are custom made on a patient by patient basis. This involves costly equipment, highly skilled technicians and can take a long time. The fabrication of ophthalmic lenses can be carried out in a more rapid and economical manner by laminating two lens wafers. This construction enables assembly of lenses having any of a large number of different combinations of optical parameters from a relatively small stock of prefabricated lens wafers of different configurations. Pairing of different combinations of the wafers can result in a range of lenses of different

powers, as the power of the lens will be the sum of the powers of the individual wafers. If bifocal or other forms of multi-focal lens are needed, wafers can be used containing such a feature.

Laminated lenses are manufactured by laminating two lens wafers with an ultra-violet curable optical adhesive. During manufacture defects in the wafer can occur. For example the inventors have found that lens wafers made from plastic material are subject to warping or distortion when exposed to heat. Such defects in the wafers are compounded in the finished lenses and if the lens produces a power error of 1/8 dioptre or more, the lens will not meet the American National Standards Institute (ANSI) Standard Z80.1 for ophthalmic lenses.

Heretofore it has not been appreciated that the temperature to which wafers are raised during lamination was sufficient to produce a change which could result in a finished lens which did not pass the ANSI standard. The inventors have found that the rejection of finished laminated lenses due to power error can be considerably reduced by ensuring that whilst curing the ultra-violet curable adhesive in the lamination process, the wafers are prevented from being heated in an unacceptable manner by filtering out the radiation emitted by the ultra-violet source, all or substantially all of which will directly or indirectly cause the wafers to be distorted.

The control of the exposure of the wafers to thermal radiation during the curing of the adhesive is not simply a matter of providing the UV source with a cooling system. UV sources can have systems which are primarily designed to protect the source from the harmful effects of overheating on the source and its associated components. This however does not reduce to a sufficient extent the emission of radiation which can result in warming of the wafers during processing. The UV source has to run at a relatively high temperature in order to operate in a satisfactory manner and hence will emit both infra-red and visible radiation. Although in the present invention the wafers are placed in a closed light tight box and are only exposed to the ultra violet source for a relatively short time period to cure the adhesive and thus form a finished lens, it has been found that using means which control the transmission of the radiation reduces the rejection of lenses which do not meet ANSI Standard Z80-1.

Methods of controlling the amount of thermal radiation to which a substrate is exposed during ultra-violet curing are well known and various proposals for carrying out this procedure are disclosed in the following US patent specifications: 4644899, 4684145, 4873446, 4880988, 4048490 and 3686940.

According to a first aspect of the present invention there is provided a process for the manufacture of laminated

ophthalmic lenses by laminating two lens wafers together with an adhesive cured by exposure to an ultra-violet light source which also emits thermal radiation, wherein substantially all of the thermal radiation is prevented from reaching the wafers during bonding, thereby reducing rejection of finished laminated lenses due to distortion induced power errors.

According to a second aspect of the present invention there is provided a laminated ophthalmic lens manufactured in accordance with the process of the first aspect wherein said lens conforms to ANSI Standard Z80-1.

According to a third aspect of the present invention there is provided a device for directly assembling finished laminated ophthalmic lenses, said device including means to assemble together, using an ultra-violet curable adhesive, a front surface providing lens wafer and a back surface providing lens wafer, said means including an ultra-violet light source and means capable of filtering out the thermal radiation produced by the ultra-violet light source and its associated parts which will directly or indirectly cause the wafers to be heated in a manner which will result in a lens which does not pass the ANSI Standard Z80.1.

Embodiments of the invention will now be described by way of example only with reference to the following drawings. In the drawings:

Figure 1 is a perspective view, partially broken away, of a laminated ophthalmic lens manufactured in accordance with the present invention

Figures 2(a) to 2(c) illustrate in schematic fashion alternative arrangements of the means used to remove heat from the optical system used in the curing of the ultra-violet adhesive in the embodiments of the invention.

Referring to Figure 1 of the drawings a laminated lens 11 is formed from a front lens wafer 12 bonded to a rear lens wafer 13 by a layer of an adhesive 14 which is one of the known types which is cured by exposure to ultra-violet radiation. The lens wafers may be made of any of the transparent plastics conventionally used for the manufacture of ophthalmic lenses.

A series of lens wafers 12 and 13 may be manufactured to provide differing amounts of optical correction and to enable the selection of particular combinations of front and rear lens wafers which together provide the desired prescription when assembled. The lens wafers shown in Figure 1 are relatively thin, usually of the order of 1 mm at the thinnest portion of the wafer, and are particularly made so

that they can only be used in the manufacture of laminated lenses. Each wafer has an observable region 16 that impairs the use of the wafer in unlaminated state for use alone as an ophthalmic lens. The regions 16 become invisible during the course of the lamination process.

During the lamination process the adhesive 14 is cured with ultra-violet light. As the ultra-violet light source has to operate at a relatively high temperature in order to operate in a satisfactory manner, the source will emit both infra-red and visible radiation. The inventors have discovered that the heat produced by the equipment used to cure the adhesive which bonds the wafers together can heat one or both wafers sufficiently to cause distortion and an unacceptable power error in the finished laminated lens. Thus in order to reduce the rejection of finished laminated lenses due to distortion induced power errors the inventors have found it necessary to prevent substantially all of the thermal radiation produced by the ultra-violet light source and its associated parts from reaching the lens wafers during bonding. Suitable ways of doing this, which in essence are the same or similar to arrangements employed in the prior art for other manufacturing processes, are shown in Figures 2(a) to 2(c).

Referring to Figures 2(a) to 2(c), in all of the embodiments shown, there is a UV lamp 20 with a filter/mirror 21 placed in the path of the radiation from the lamp 20. The

UV radiation is directed by the mirror 21 onto the assembly 22 which is made up of two wafers with UV curable adhesive between them supported in a mounting which is enclosed in a light tight box (not shown) with a shutter which opens to allow the UV radiation to impinge on the assembly.

In the preferred form of our invention shown in Figure 2(a), the mirror 21 is a so-called cold mirror which transmits infra-red radiation and reflects UV radiation onto the wafer assembly 22 when the lamp is on and the shutter open.

In the embodiment shown in Figure 2(b) the mirror 21 reflects both infra-red and UV radiation and a so-called hot mirror 24 is provided between the mirror 21 and the wafer assembly which reflects infra-red radiation and transmits UV radiation. Such partially transmissive mirrors are already well known and have on their surface a plurality of thin layers or films of metal oxides having dielectric properties, the combination of which is chosen to give a particular transmission resulting in either a hot mirror or a cold mirror.

In the embodiment shown in Figure 2(c) the mirror 21 is arranged to reflect both infra-red and UV radiation towards the wafer assembly 22 and interposed in the path of the radiation is an infra-red radiation absorbing plate 25. This plate is cooled by air which flows through a delivery nozzle 27 and is exhausted from the equipment through the exhaustion port 28.

Suitable filters are available in the form of coated borosilicate glass from companies such as Edmunds Scientific and Mellees Griot and are sold as heat reflecting mirrors or hot mirrors and heat transmitting mirrors or cold mirrors. These are of course readily available means which are sold for the purpose of removing heat from an optical system at selected spot in the system and our invention is directed to their application for a specific purpose in a specific manner.

The inventors have found that in each embodiment of the invention the proportion of finished lenses which conform to ANSI Standard Z80.1 is increased when compared to conventional laminating processes.

CLAIMS

1. A process for the manufacture of laminated ophthalmic lenses by laminating two lens wafers together with an adhesive cured by exposure to an ultra-violet light source which also emits thermal radiation, wherein substantially all of the thermal radiation is prevented from reaching the wafers during bonding, thereby reducing rejection of finished laminated lenses due to distortion induced power errors.

2. A laminated ophthalmic lens manufactured in accordance with the process of claim 1 wherein said lens conforms to ANSI Standard Z80.1.

3. A device for directly assembling finished laminated ophthalmic lenses, said device including means to assemble together, using an ultra-violet curable adhesive, a front surface providing lens wafer and a back surface providing lens wafer, said means including an ultra-violet light source and means capable of filtering out the thermal radiation produced by the ultra-violet light source and its associated parts which will directly or indirectly cause the wafers to be heated in a manner which will result in a lens which does not pass the ANSI Standard Z80.1.

4. A process for the manufacture of laminated ophthalmic lenses substantially as hereinbefore described with

reference to and as illustrated in Figures 2(a) to 2(c).

5. A laminated ophthalmic lens substantially as hereinbefore described with reference to and as illustrated in Figure 1.

6. A device for directly assembling finished laminated ophthalmic lenses substantially as hereinbefore described.

Patents Act 1977
Examiner's report to the Comptroller under section 17 (The Search Report)

Application number
GB 9123178.7

Relevant Technical fields

(i) UK Cl (Edition K) B5N, G2J

(ii) Int Cl (Edition 5) B32B, G02C, B29D, C03B

Search Examiner
R J MIRAMS

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI, CLAIMS

Date of Search
15 JANUARY 1993

Documents considered relevant following a search in respect of claims 1 TO 6

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

SJJ - doc99\fil001310

SF2(p)

Category	Identity of document and relevant passages	Relevant to claim(s.

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

Published 1993 at The Patent Office, Concept House, Cardiff Road, Newport, Gwent NP9 1RH. Further copies may be obtained from Sales Branch, Unit 6, Nine Mile Point, Cwmfelinfach, Cross Keys, Newport, NP1 7HZ. Printed by Multiplex techniques ltd, St Mary Cray, Kent.